REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicants thank the Examiner for carefully considering this application and for indicating the acceptance of the formal drawings filed on September 3, 2003.

Disposition of Claims

Claims 14-33 were pending in this application. By way of this reply, claim 15 has been cancelled without prejudice or disclaimer. Accordingly, claims 14 and 16-33 are now pending in the application. Claims 14, 21, 27, 30 and 31 are independent. The remaining claims depend, either directly or indirectly, from claims 14, 21, 27, and 31.

Claim Amendments

Claim 14 is amended to include the limitations of now-cancelled claim 15. Claims 21, 30, and 31 are amended to recite similar limitations. Applicants respectfully assert no new matter has been added by way of these amendments.

Rejection(s) under 35 U.S.C § 103

Claims 14-33 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over "Skip Lists: A Probalistic Alternative to Balanced Trees" by William Pugh (hereinafter "Pugh") in view of U.S. Patent No. 6,651,146 (hereinafter "Srinivas"). Claim 15 is canceled by way of this reply. Thus, the rejection is now moot with respect to claim 15. To the extent, this rejection still applies to the remaining amended claims, the rejection is respectfully traversed.

To establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a), "the prior art reference (or references when combined) must teach or suggest all the claim limitations." *See* MPEP § 2143.03. "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims prima facie obvious." *See* MPEP § 2143.01. Further, "in order to rely on equivalence as a rationale supporting an obviousness rejection, the equivalency must be recognized in the prior art, and cannot be based on applicant's disclosure or the mere fact that the components at issue are functional or mechanical equivalents." *See* MPEP § 2144.06.

As an initial matter, Applicants note the Examiner relied on U.S. Patent No. 6,551,146, which is a completely unrelated patent to the technology at hand, in rejecting claims 14-33 under 35 U.S.C. § 103(a). *See* Office Action dated July 3, 2007 at page 3. The Applicants determined based on the named inventor and the list of references provided with the last Office Action dated January 11, 2007, that the Examiner appears to be referring to U.S. Patent No. 6,651,146. As it appears the reference to U.S. Patent No. 6,551,146 was a typographical mistake, Applicants have responded to this office action accordingly. If this belief by the Applicant is incorrect, Applicants request that the Examiner please advise us immediately.

Turning to the rejection of claims 14 and 16-33, Applicants assert that the references, whether viewed separately or in combination, fail to teach or suggest each and every limitation of amended independent claims 14, 21, 27, 30, and 31. Amended independent claim 1 recites, in part,

> operating on the shared data structure using insert-type and delete-type operations that are linearizable and lock-free for all concurrent executions thereof,
>
> wherein the *insert-type* operation performs a synchronized update of pointers beginning at the first level thereof and continuing *upward*, and
>
> wherein the *delete-type* operation performs a synchronized update of pointers beginning at a K^{th} level thereof and continuing *downward* to the first level.

Amended independent claims 21, 30, and 31, and original independent claim 27 recite similar limitations. In other words, claim 1 is directed toward a method of operating on a shared data structure using an insert-type operation and a delete-type operation that performs synchronized updates of pointers *in opposite directions.* Specifically, the *insert-type* operations begin updating pointers at a first level of the referencing chains and continue *upward* while the *delete-type* operations being updating pointers at a K^{th} level of the referencing chain and continue *downward* to the first level. The *opposite directions of updates* to the pointers for the insert-type operations and delete-type operations allow for linearizable and lock-free concurrent executions of the insert-type and delete-type operations for skip lists. *See* Instant Specification, paragraphs [1059]-[1061].

While Pugh may describe an insert-type operation and a delete-type operation (*see* Pugh, Figure 4), Pugh does not disclose an insert-type operation and a delete-type operation that update pointers in *opposite directions* to allow for linearizable and lock-free concurrent executions of the insert-type and delete-type operations for skip lists, as explicitly recited in the pending claims.

Specifically, Pugh teaches an insert operation that updates pointers beginning at level 1 and going upward. *See, e.g.,* Pugh, Figure 4 at lines 19-21:

```
for i:=1 to level do
        x→forward[i] :=update[i]→forward[i]
        update[i]→forward[i] :=x
```

Furthermore, Pugh teaches a delete operation that updates pointers in the *same direction as the insert operation, i.e.*, beginning at level 1 and going upward. *See, e.g.,* Pugh, Figure 4 at lines 32-34:

```
for i:=1 to list→level do
        if update[i]→forward[i] ≠ x then break
        update[i]→forward[i] := x→forward[i]
```

It would be clear to a person of ordinary skill in the art that an insert operation and a delete operation that update pointers in the *same* direction as described in Pugh are not equivalent to an insert-type operation and delete-type operation that update pointers in the *opposite* direction, as explicitly recited in independent claim 1.

Furthermore, an insert operation and a delete operation that update pointers in the *same direction* in a skip list cannot be executed concurrently in a linearizable and lock-free manner because concurrently operating insert and delete operations without locks in a linearizable manner may lead to data inconsistencies. For example, an insert operation and a delete operation concurrently executing on the same node may lead to data inconsistencies as each operation is not aware of other concurrent operations associated with the same node leading to overwritten inconsistent data in a single node. Therefore, in order to avoid data inconsistencies, skip lists with concurrently executing insertion and deletion operations with updates to pointers in the same direction, as taught in Pugh, requires implementation using locking mechanisms and/or are non-linearizable and accordingly, cannot be combined with linearizable and lock-free pointer update operations, that are allegedly described in Srinivas. *See* Instant Specification, paragraph [1008]. Therefore, the proposed combination of the single-directional pointer updates of concurrent insertion and deletion operations of Pugh with linearizable and lock-free update operations, allegedly disclosed in Srinivas, changes the principle of operation of the prior art, which is wholly improper.

Thus, the combination of Pugh and Srinivas, whether considered separately or in combination, fail to render independent claims 14, 21, 27, 30, and 31 obvious. Claims 16-20, 22-26, 28, 29, 32, and 33, which depend, directly or indirectly, from claims 14, 21, 27, and 31, are patentable over Pugh, in view of Srinivas for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicants believe this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 33226/972001).

Dated: October 3, 2007 Respectfully submitted,

By /Robert P. Lord/
Robert P. Lord
Registration No.: 46,479
OSHA · LIANG LLP
1221 McKinney St., Suite 2800
Houston, Texas 77010
(713) 228-8600
(713) 228-8778 (Fax)
Attorney for Applicants